

## DC-8 Aircraft Measurements of Atmospheric CO<sub>2</sub> during INTEx-A [NASA Langley Research Center, Hampton, VA]

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We will provide accurate, high precision measurements of atmospheric carbon dioxide (CO<sub>2</sub>) aboard the NASA DC-8 during INTEx-A. These fast-response measurements will be made by an infrared gas analyzer-based sampling system designed to provide fundamental information on the distribution and cycling of CO<sub>2</sub> among the active land, ocean, and atmospheric reservoirs. These in-situ CO<sub>2</sub> measurements will contribute to addressing several major objectives of the North American Carbon Program, namely: (1) large-scale characterization of the spatio-temporal variance of CO<sub>2</sub> concentrations over North America (2) evaluation of the representative-ness of ground-based observations (3) testing of models that assimilate surface observations to derive regional to continental scale CO<sub>2</sub> flux estimates (4) provide integrated measures of atmospheric column amounts from DC-8 vertical soundings for retrieval algorithm development and validation of remotely-sensed data products and (5) offer an independent assessment of the uncertainties generated by scaling issues.

A modified LI-COR model 6252 infrared gas analyzer forms the basis of the CO<sub>2</sub> sampling system that has been successfully deployed aboard aircraft during the PEM-West [Anderson et al., 1996; Gregory et al., 1997], PEM-Tropics [Vay et al., 1999], and TRACE [Vay et al., 2003] mission series. The LI-COR is small (13 x 24 x 34 cm) and composed of dual 11.9 cm<sup>3</sup> volume sample/reference cells; a feedback stabilized infrared source; 500 Hz chopper; thermoelectrically-cooled solid state PbSe detector; and a narrow band (150 nm) interference filter centered on the 4.26 μm CO<sub>2</sub> absorption band. Using synchronous signal detection techniques, it operates by sensing the difference in light absorption between the continuously flowing sample and reference gases occupying each side of the dual absorption cell. Thus, by selecting a reference gas of approximately the same concentration as background air (~ 375 ppmv), very minute fluctuations in atmospheric concentration can be quantified with high precision (≤ 0.07 ppmv). The system is operated at constant pressure (250 torr) and has a response time of 1 second.

During ambient sampling, air is continuously drawn through a Rosemount inlet probe, a permeable membrane dryer to remove H<sub>2</sub>O<sub>(v)</sub>, the LI-COR, and then exchanged through a diaphragm pump that vents overboard. In-flight calibrations are performed every 15 minutes using standards traceable to the WMO Central CO<sub>2</sub> Laboratory. By interpolating between these calibrations, slow drifts in instrument response are effectively suppressed, yielding high precision values. Temperature control of the instrument minimizes thermal drift thus maximizing ambient sampling time by decreasing the frequency of calibrations. The CO<sub>2</sub> measurement accuracy is closely tied to the accuracy of the standards obtained from NOAA/CMDL, Boulder, CO prior to the mission.

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